



*Power lines along a Xiao Qing Dao village street overlook the ocean.*

Charlie Doe/Beijing Bergey Windpower

# Renewable Energy in China

## Xiao Qing Dao Village Power Wind/Diesel Hybrid Pilot Project

### Background

Xiao Qing Dao is a small island located in China's Yellow Sea four nautical miles from Rushan, a coastal city of Shandong Province. Its name means "little green island," and the description is apt. The island is clean and lush, and only approximately 370 people, or 123 households, are permanent residents there. An additional 130 or so people are temporary residents, employed in seasonal fishing work. Most residents of the island earn their livelihood from fishing and fish-farming. Xiao Qing Dao has been populated since the 18th century, and almost all permanent households trace their island birthright back five generations.

In 2000, DOE/NREL and the State Power Corporation of China (SPCC) developed a pilot project to electrify the island using a wind/diesel/battery hybrid system. The project was intended to demonstrate the practicality of renewable energy systems for medium-scale, off-grid applications. Xiao Qing Dao was an ideal location due to its enjoying strong wind resources almost year-round, and its convenience of access for local utility officials. In addition, the project received strong support from the city of Rushan, the City Power Bureau, and the Island Council.

The system consists of four 10-kW wind turbines connected to a 30-kW diesel generator, a 40-kW inverter, and battery bank. DOE provided the turbines from Bergey Windpower, as well as the battery bank, the inverter, and spare parts (supplied by U.S. manufacturers). SPCC provided the diesel generator, turbine towers, foundations, buildings, and electrical equipment;



*A view of Xiao Qing Dao on approach to the harbor.*

Kristin K. Stroup

in addition, SPCC was responsible for operation, maintenance, and data collection. Installation of the system began in February 2001.

Prior to installation of the pilot project system, island residents depended on a 13-kW diesel engine-run generator set which provided electricity for only 3-4 hours in the evening, intermittently. The electricity from this system was used to power low-wattage lighting and satellite TVs. With the hybrid system, residents enjoy nearly 24-hour electricity which powers street lighting, good-quality indoor lighting, cable TVs, DVDs/VCDs, refrigerators, washing machines, stereos, water coolers, satellite phones, and electric cookers. In addition, the current electricity is provided at a lower cost to island residents. Previously, they paid 3 Yuan per kilowatt-hour (kWh) (about US\$0.36) for the diesel generator. Currently, they pay 1 Yuan/kWh (about US\$0.12) when relying solely on wind power. Though necessary only occasionally during prolonged periods of low wind, the addition of diesel to system operation raises the cost to 2 Yuan/kWh.

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*Residents of the village return from a day at work.*

## Post-installation assessment

NREL has overseen data collection from the system since operation began in 2001, and NREL personnel have returned to Xiao Qing Dao three times since project inception. The system has performed well, and residents report a high level of satisfaction with the service.

Xiao Qing Dao has proved the ideal location for the pilot project for another reason: its potential for productive use applications. A productive use is here defined as an activity that leads, indirectly or directly, to generation of income. Obvious examples are small business development, refrigeration of seafood products or beer for sale, small handicrafts, and tourism. However, other productive uses include time and labor savings garnered by use of washing machines and other appliances, and more efficient use of renewable energy instead of diesel, which saves household income for other uses. Finally, activities that have the potential to generate enhanced human capital, such as education, are also considered productive uses.

On Xiao Qing Dao, residents have been able to raise their incomes through use of refrigerators for preserving fish for sale. Since the system was installed in November 2000, eleven children have gone to college—some have even continued on to graduate school. Previous to system installation, no resident of the island had ever gone to college. The mayor of the island, and its residents, attributed the

children's success entirely to high-quality lighting that allowed for increased study time during the evening. These facts lend validity to the claim that electrification leads, whether directly or indirectly, to higher educational achievement.

The following fact sheets on renewable energy in China are available on the National Renewable Energy Laboratory's China Web site ([www.nrel.gov/china](http://www.nrel.gov/china)).

- WB/GEF Renewable Energy Development Project
- Grid Connected Wind Power in China
- Renewable Energy Policy in China: Overview
- Renewable Energy Policy in China: Financial Incentives
- Township Electrification Program
- China's Plan for Renewable Energy
- Brightness Rural Electrification Program
- Renewable Energy Business Partnerships in China
- Development of the Geothermal Heat Pump Market in China
- Xiao Qing Dao Village Power Wind/Diesel Hybrid Pilot Project

These fact sheets were prepared by DOE/NREL and the China Renewable Energy Industries Association under the US/China Protocol for Cooperation in the Fields of Energy Efficiency and Renewable Energy Technology Development and Utilization.

## For more information, please contact:

The National Renewable Energy Laboratory China Web site:  
[www.nrel.gov/international/china](http://www.nrel.gov/international/china)

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